Adapting the Reactive Search Optimization and Visualization Algorithms for Multiobjective Optimization Problems; Application to Geometry

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In most of the real-world optimal design problems of engineering and business processes, in order to improve the functionality, the operating parameters need to be accurately tuned with the aid of the multiobjective optimization algorithms for which many conflicting objectives have to be traded off in selecting the preferred solution(s). For solving the complicated multiobjective optimization problems numerous biology-inspired metaphors e.g. evolutionary algorithms [1] which have indeed a very limited learning capabilities, have been widely utilized so far.

On the other hand very recently the effectiveness of reactive search optimization (RSO) algorithms [3, 9] along with the visualization tools [2], in operations research and mathematical programming, covering a variety of different applications to multiobjective optimization, are becoming increasingly popular. The RSO algorithms, considered as the most advanced Brain-Computer Optimization (BCO) algorithms, are developed on the basis of involving the decision maker interactively in the loop; loading the intelligent expertise to the algorithm leading to increasing the learning capabilities. RSO employs learning for optimization, via integration of sub-symbolic machine learning techniques into the search heuristics so that the algorithm selection, adaptation and integration, are done in a rather automated way. In this way the past history of the search could be used for self-adaptation in an automated manner. Moreover visualization and optimization are connected through decision maker interaction.

In this article the RSO algorithms are compared with the evolutionary algorithms in terms of the effectiveness, usability, and efficiency. To do so three of the well-known geometrical optimization problems, previously solved by evolutionary algorithms, i.e. multiobjective optimization the curves and surfaces [4, 10], skinning problem [5], and welded beam design [6], are reconsidered utilizing RSO and visualization tools via a commercial implementation [7, 8]. The results are further carefully discussed in each study case.

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